



ENVIRONMENTAL PROTECTION AGENCY

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40 CFR Part 82

[EPA-HQ-OAR-2003-0118; FRL-9984-77-OAR]

RIN 2060-AG12

Protection of Stratospheric Ozone: Determination 34 for Significant New Alternatives

Policy Program

AGENCY: Environmental Protection Agency (EPA).

ACTION: Determination of acceptability.

SUMMARY: This determination of acceptability expands the list of acceptable substitutes pursuant to the U.S. Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program. This action lists as acceptable additional substitutes for use in the refrigeration and air conditioning, foam blowing, fire suppression, cleaning solvents, and aerosols sectors.

DATES: This determination is applicable on **[Insert date of publication in the Federal Register]**.

ADDRESSES: EPA established a docket for this action under Docket ID No. EPA-HQ-OAR-2003-0118 (continuation of Air Docket A-91-42). All electronic documents in the docket are listed in the index at www.regulations.gov. Although listed in the index, some information is not publicly available, i.e., Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Publicly available docket materials are available either electronically at www.regulations.gov or in hard copy at the EPA Air Docket (Nos. A-91-42 and EPA-HQ-OAR-2003-0118), EPA Docket Center (EPA/DC), William J. Clinton West, Room

3334, 1301 Constitution Avenue, NW, Washington, DC 20460. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742.

FOR FURTHER INFORMATION, CONTACT: Gerald Wozniak by telephone at (202) 343-9624, by e-mail at wozniak.gerald@epa.gov, or by mail at U.S. Environmental Protection Agency, Mail Code 6205T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Overnight or courier deliveries should be sent to the office location at 1201 Constitution Avenue, NW, Washington, DC 20004.

For more information on the Agency's process for administering the SNAP program or criteria for the evaluation of substitutes, refer to the initial SNAP rulemaking published in the Federal Register on March 18, 1994 (59 FR 13044). Notices and rulemakings under the SNAP program, as well as other EPA publications on protection of stratospheric ozone, are available at EPA's Ozone Layer Protection website at www.epa.gov/ozone-layer-protection including the SNAP portion at www.epa.gov/snap/.

SUPPLEMENTARY INFORMATION:

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Appendix A: Summary of Decisions for New Acceptable Substitutes

I. Listing of New Acceptable Substitutes¹

This action is limited to listing as acceptable additional substitutes for use in the refrigeration and air conditioning, foam blowing, fire suppression, cleaning solvents, and aerosols sectors. This action presents EPA's most recent decision to list as acceptable several substitutes throughout different SNAP end-uses. New substitutes are:

- R-448A in ice skating rinks (retrofit equipment only);
- R-449A in ice skating rinks (retrofit equipment only);
- R-449B in ice skating rinks (retrofit equipment only);
- R-450A in ice skating rinks (new and retrofit equipment);
- R-513A in ice skating rinks (new and retrofit equipment);
- Acetone/isopentane blend in rigid polyurethane and polyisocyanurate laminated boardstock;
- Powdered Aerosol E in total flooding fire suppression (normally occupied areas); and
- HFO-1336mzz(Z) in electronics cleaning, metals cleaning, and precision cleaning and aerosol solvents.

¹ On April 27, 2018 (83 FR 18431) EPA provided information on the Agency's plan to address the decision of the Court of Appeals for the District of Columbia Circuit in the case of Mexichem Fluor, Inc. v. EPA. That decision vacated the 2015 Rule (80 FR 42870) "to the extent it requires manufacturers to replace HFCs with a substitute substance" and remanded the rule to EPA for further proceedings. EPA plans to issue a proposed rule to address the court's vacatur and remand in early 2019.

EPA's review of certain substitutes listed in this document is pending for other end-uses. Listing in the end-uses and applications in this document does not prejudice EPA's listing decision for these substitutes for other end-uses. For many of the substitutes being added through this document to the acceptable lists for specific end-uses, there are other listed substitutes for the end-use whose overall risk is comparable except that they have a lower risk in one SNAP criterion, for example toxicity or global warming potential (GWP). However, for the end-uses addressed in this action, those alternatives have not yet proven feasible in those specific end-uses.

For additional information on SNAP, visit the SNAP portion of EPA's Ozone Layer Protection website at: www.epa.gov/snap. Copies of the full lists of acceptable substitutes for ozone depleting substances (ODS) in all industrial sectors are available at www.epa.gov/snap/substitutes-sector. For more information on the Agency's process for administering the SNAP program or criteria for evaluation of substitutes, refer to the initial SNAP rulemaking published March 18, 1994 (59 FR 13044), codified at 40 CFR part 82, subpart G. SNAP decisions and the appropriate Federal Register citations are found at: www.epa.gov/snap/snap-regulations. Substitutes listed as unacceptable; acceptable, subject to narrowed use limits; or acceptable, subject to use conditions are also listed in the appendices to 40 CFR part 82, subpart G.

The sections below discuss each substitute listing in detail. Appendix A contains tables summarizing this action's listing decisions. The statements in the "Further Information" column in the tables provide additional information but these are not legally binding under section 612 of the Clean Air Act (CAA). In addition, the "Further Information" column may not include a

comprehensive list of other legal obligations you may need to meet when using the substitute. Although you are not required to follow recommendations in the “Further Information” column of the table to use a substitute consistent with section 612 of the CAA, some of these statements may refer to obligations that are enforceable or binding under federal or state programs other than the SNAP program. In many instances, the information simply refers to standard operating practices in existing industry standards and/or building codes. When using these substitutes, EPA strongly encourages you to apply the information in this column. Many of these recommendations, if adopted, would not require significant changes to existing operating practices.

You can find submissions to EPA for the substitutes listed in this document, as well as other materials supporting the decisions in this action, in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov.

A. Refrigeration and Air Conditioning

1. R-448A

EPA’s decision: EPA finds R-448A acceptable as a substitute for use in:

- Ice skating rinks (retrofit equipment only)

R-448A, marketed under the trade name Solstice[®] N-40, is a weighted blend of 26 percent hydrofluorocarbon (HFC)-32, which is also known as difluoromethane (Chemical Abstracts Service Registry Number [CAS Reg. No.] 75-10-5); 26 percent HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); 21 percent HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); 20 percent hydrofluoroolefin (HFO)-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS

Reg. No 754-12-1); and seven percent HFO-1234ze(E), which is also known as *trans*-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 30 Listing of R-448A (N-40) in Certain Refrigeration and Air Conditioning End-Uses Submission Received May 29, 2014.” EPA performed assessments to examine the health and environmental risks of this substitute. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes in Ice Skating Rinks Substitute: R-448A (Solstice® N-40)”

EPA previously listed R-448A as an acceptable refrigerant in a number of other refrigeration and air conditioning end-uses (e.g., July 16, 2015, 80 FR 42053; October 11, 2016, 81 FR 70029; July 21, 2017, 82 FR 33809).

Environmental information: R-448A has an ozone depletion potential (ODP) of zero. Its components, HFC-32, HFC-125, HFC-134a, HFO-1234yf, and HFO-1234ze(E) have GWPs of 675; 3,500; 1,430; one to four;^{2,3} and one to six;⁴ respectively. If these values are weighted by mass percentage, then R-448A has a GWP of about 1,390. The components of R-448A are

² Hodnebrog Ø., Etminan, M., Fuglestad, J.S., Marston, G., Myhre, G., Nielsen, C.J., Shine, K.P., Wallington, T.J.: Global Warming Potentials and Radiative Efficiencies of Halocarbons and Related Compounds: A Comprehensive Review, *Reviews of Geophysics*, 51, 300–378, doi:10.1002/rog.20013, 2013

³ Nielsen, O. J., Javadi, M. S., Sulbaek Andersen, M. P., Hurley, M. D., Wallington, T. J., Singh, R. Atmospheric chemistry of CF₃CF=CH₂: Kinetics and mechanisms of gas-phase reactions with Cl atoms, OH radicals, and O₃. *Chemical Physics Letters* 439, 18-22, 2007.

⁴ Hodnebrog *et al.*, 2013 and Atmospheric chemistry of *trans*-CF₃CH=CHF: products and mechanisms of hydroxyl radical and chlorine atom initiated oxidation”, M.S. Javadi, R. Søndergaard, O.J. Nielsen, M.D., Hurley, and T.J. Wallington, *Atmospheric Chemistry and Physics Discussions* 8, 1069–1088, 2008

excluded from the definition of volatile organic compounds (VOC) under CAA regulations (see 40 CFR 51.100(s)) addressing the development of state implementation plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS). Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

Flammability information: R-448A, as formulated and even considering the worst-case fractionation for flammability, is not flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The American Industrial Hygiene Association (AIHA) has established workplace environmental exposure limits (WEELs) of 1,000 ppm as an eight-hour time-weighted (TWA) for HFC-32, HFC-125, and HFC-134a; 500 ppm for HFO-1234yf; and 800 ppm for HFO-1234ze(E), the components of R-448A. The manufacturer of R-448A recommends an acceptable exposure limit (AEL) of 890 ppm on an 8-hour TWA for the blend. EPA anticipates that users will be able to meet the AIHA WEELs and manufacturer's AEL and address potential health risks by following requirements and recommendations in the manufacturer's safety data sheet (SDS), in the American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in this end-use: R-448A has an ODP of zero, comparable to or lower than other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-448A's GWP of 1,390 is lower than or comparable to that of acceptable substitutes for ice skating rinks (retrofit), such as HFC-134a, R-407C, and R-507A, with GWPs ranging from 1,430 to 3,990. R-448A's GWP is higher than the GWPs of other acceptable substitutes for ice skating rinks (retrofit), including R-401A and R-401B with GWPs ranging from 1,182 to 1,288.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15 and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-448A acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

2. R-449A

EPA's decision: EPA finds R-449A acceptable as a substitute for use in:

- Ice skating rinks (retrofit equipment only)

R-449A, marketed under the trade name Opteon[®] XP 40, is a weighted blend of 24.3 percent HFC-32, which is also known as difluoromethane (CAS Reg. No. 75-10-5); 24.7 percent HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); 25.7 percent HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and 25.3 percent HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 30 Listing of R-449A (XP40) in Certain Refrigeration and Air Conditioning End-Uses. SNAP Submission Received August 6, 2014.” EPA performed assessments to examine the health and environmental risks of this substitute. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes in Ice Skating Rinks Substitute: R-449A (Opteon® XP40)”

EPA previously listed R-449A as an acceptable refrigerant in a number of other refrigeration and air conditioning end-uses (e.g., July 16, 2015, 80 FR 42053; October 11, 2016, 81 FR 70029; July 21, 2017, 82 FR 33809).

Environmental information: R-449A has an ODP of zero. Its components, HFC-32, HFC-125, HFC-134a, and HFO-1234yf, have GWPs of 675; 3,500; 1,430; and one to four,⁵ respectively. If these values are weighted by mass percentage, then R-449A has a GWP of about 1,400. The components of R-449A are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

Flammability information: R-449A, as formulated and even considering the worst-case fractionation for flammability, is not flammable.

⁵ Hodnebrog *et al.*, 2013 and Nielsen *et al.*, 2007. *Op. cit.*

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm as an 8-hr TWA for HFC-32, HFC-125, and HFC-134a and 500 ppm for HFO-1234yf, the components of R-449A. The manufacturer of R-449A recommends an AEL of 830 ppm on an 8-hour TWA for the blend. EPA anticipates that users will be able to meet each of the AIHA WEELs and the manufacturer's AEL and address potential health risks by following requirements and recommendations in the manufacturer's SDS, in ASHRAE 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in this end-use: R-449A has an ODP of zero, comparable to or lower than the other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-449A's GWP of 1,400 is lower than or comparable to that of acceptable substitutes for ice skating rinks (retrofit), such as HFC-134a, R-407C, and R-507A with GWPs ranging from 1,430 to 3,990. R-449A's GWP is higher than the GWPs of other acceptable substitutes for ice skating rinks (retrofit), including R-401A and R-401B with GWPs ranging from 1,182 to 1,288.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-uses. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15 and other industry standards, recommendations

in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-449A acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

3. R-449B

EPA's decision: EPA finds R-449B acceptable as a substitute for use in:

- Ice skating rinks (retrofit equipment only)

R-449B, marketed under the trade name Forane[®] 449B, is a weighted blend of 25.2 percent HFC-32, which is also known as difluoromethane (CAS Reg. No. 75-10-5); 24.3 percent HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); 27.3 percent HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and 23.2 percent HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, "Supporting Documentation for Notice 32 Listing of R-449B in Refrigeration and Air Conditioning. SNAP Submission Received October 2, 2015." EPA performed assessments to examine the health and environmental risks of this substitute. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- "Risk Screen on Substitutes in Ice Skating Rinks Substitute: R-449B (Forane[®] 449B)"

EPA previously listed R-449B as an acceptable refrigerant in a number of other refrigeration and air conditioning end-uses (e.g., October 11, 2016, 81 FR 70029; July 21, 2017, 82 FR 33809).

Environmental information: R-449B has an ODP of zero. Its components, HFC-32, HFC-125, HFC-134a, and HFO-1234yf, have GWPs of 675; 3,500; 1,430; and one to four,⁶ respectively. If these values are weighted by mass percentage, then R-449B has a GWP of about 1,410. The components of R-449B are excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

Flammability information: R-449B, as formulated and even considering the worst-case fractionation for flammability, is not flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm as an 8-hr TWA for HFC-32, HFC-125, and HFC-134a and 500 ppm for HFO-1234yf, the components of R-449B. The manufacturer of R-449B recommends an AEL of 865 ppm on an 8-hour TWA for the blend. EPA anticipates that

⁶ Hodnebrog *et al.*, 2013 and Nielsen *et al.*, 2007. *Op. cit.*

users will be able to meet each of the AIHA WEELs and the manufacturer's AEL and address potential health risks by following requirements and recommendations in the manufacturer's SDS, in ASHRAE 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in this end-use: R-449B has an ODP of zero, comparable to or lower than the other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-449B's GWP of 1,410 is lower than or comparable to that of acceptable substitutes for ice skating rinks (retrofit), such as HFC-134a, R-407C, and R-507A with GWPs ranging from 1,430 to 3,990. R-449B's GWP is higher than the GWPs of other acceptable substitutes for ice skating rinks (retrofit), including R-401A and R-401B with GWPs ranging from 1,182 to 1,288.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15 and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-449B acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

4. R-450A

EPA's decision: EPA finds R-450A acceptable as a substitute for use in:

- Ice skating rinks (new and retrofit equipment)

R-450A, marketed under the trade name Solstice® N-13, is a weighted blend of 42 percent HFC-134a, which is also known as 1,1,1,2 tetrafluoroethane (CAS Reg. No. 811-97-2), and 58 percent HFO-1234ze(E), which is also known as *trans*-1,3,3,3-tetrafluoropro-1-ene (CAS Reg. No. 29118-24-9).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Materials for Notice 30 Listing of R-450A in Vending Machines.” EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Ice Skating Rinks Substitute: R-450A”

EPA previously listed R-450A as acceptable for use as a refrigerant in several refrigeration and air conditioning end-uses (October 21, 2014, 79 FR 62863; July 16, 2015, 80 FR 42053).

Environmental information: R-450A has an ODP of zero. Its components, HFC-134a and HFO-1234ze(E), have GWPs of 1,430 and one to six,⁷ respectively. If these values are weighted by mass percentage, then R-450A has a GWP of about 600. The components of R-450A are both excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

⁷ Hodnebrog *et al.*, 2013 and Nielsen *et al.*, 2007. *Op. cit.*

Flammability information: R-450A, as formulated and even considering the worst-case fractionation for flammability, is not flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm and 800 ppm as an 8-hour TWA for HFC-134a and HFO-1234ze(E), respectively, the components of R-450A. The manufacturer of R-450A recommends an AEL of 880 ppm on an 8-hour TWA for the blend. EPA anticipates that users will be able to meet each of the manufacturer's AEL and AIHA WEELs and address potential health risks by following requirements and recommendations in the manufacturer's SDS, in ASHRAE 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in this end-use: R-450A has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-450A's GWP of 600 is lower than that of other acceptable substitutes (for new and retrofit use for ice skating rinks) such as HFC-134a, R-407C, and R-507A with GWPs ranging from 1,430 to 3,990. R-450A's GWP is higher than the GWPs of other acceptable substitutes for new ice skating rinks, including ammonia absorption, ammonia vapor compression and carbon dioxide with GWPs ranging from zero to 1.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15, and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-450A acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

5. R-513A

EPA's decision: EPA finds R-513A acceptable as a substitute for use in:

- Ice skating rinks (new and retrofit equipment)

R-513A, marketed under the trade name Opteon[®] XP 10, is a weighted blend of 44 percent HFC-134a, which is also known as 1,1,1,2 tetrafluoroethane (CAS Reg. No. 811-97-2), and 56 percent HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, "Supporting Documentation for Notice 30 Listing of R-513A (XP10) in Certain Refrigeration and Air Conditioning End-Uses. SNAP Submission Received July 24, 2014." EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- "Risk Screen on Substitutes for Use in Ice Skating Rinks Substitute: R-513A"

EPA previously listed R-513A as acceptable for use as a refrigerant in several refrigeration and air conditioning end-uses (July 16, 2015, 80 FR 42053; May 23, 2016, 81 FR 32241; July 21, 2017, 82 FR 33809).

Environmental information: R-513A has an ODP of zero. Its components, HFC-134a and HFO-1234yf, have GWPs of 1,430 and one to four,⁸ respectively. If these values are weighted by mass percentage, then R-513A has a GWP of about 630. The components of R-513A are both excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

Flammability information: R-513A, as formulated and even considering the worst-case fractionation for flammability, is not flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many refrigerants.

The AIHA has established WEELs of 1,000 ppm and 500 ppm as an 8-hour TWA for HFC-134a and HFO-1234yf, respectively, the components of R-513A. The manufacturer of R-513A recommends an AEL of 653 ppm on an 8-hour TWA for the blend. EPA anticipates that

⁸ Hodnebrog *et al.*, 2013 and Nielsen *et al.*, 2007. *Op. cit.*

users will be able to meet each of the manufacturer's AEL and AIHA WEELs and address potential health risks by following requirements and recommendations in the manufacturer's SDS, in ASHRAE 15, and other safety precautions common to the refrigeration and air conditioning industry.

Comparison to other substitutes in this end-use: R-513A has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-513A's GWP of 630 is lower than that of other acceptable substitutes for new and retrofit use for ice skating rinks, such as HFC-134a, R-407C, and R-507A with GWPs ranging from 1,430 to 3,990. R-513A's GWP is higher than the GWPs of other acceptable substitutes for new ice skating rinks, including ammonia absorption, ammonia vapor compression and carbon dioxide with GWPs ranging from zero to 1.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15, and other industry standards, recommendations in the manufacturer's SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-513A acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

B. Foam Blowing

1. Acetone/Isopentane blend

EPA's decision: EPA finds Acetone/Isopentane blend acceptable as a substitute for use in:

- Rigid polyurethane and polyisocyanurate laminated boardstock

Acetone/Isopentane, is a weighted blend of 10-30 percent acetone (CAS Reg. No. 67-64-1) and 70-90 percent isopentane (CAS Reg. No. 78-78-4).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 34 Listing of Acetone/Isopentane blend in rigid polyurethane and polyisocyanurate laminated boardstock. SNAP Submission Received August 8, 2017.” EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Rigid polyurethane and polyisocyanurate laminated boardstock Substitute: Acetone/Isopentane blend”

EPA previously listed acetone as acceptable for use as a foam-blowing agent in flexible polyurethane and in integral skin polyurethane (March 18, 1994, 59 FR 13044; February 24, 1998, 63 FR 9151). EPA previously listed C3-C6 light saturated hydrocarbons, which include isopentane, as acceptable for use as a foam-blowing agent in a number of foam-blowing end-uses. (August 26, 1994, 59 FR 44240; April 11, 2000, 65 FR 19327).

Environmental information: Acetone/isopentane blend has an ODP of zero. Its components, acetone and isopentane, have GWPs of 0.5 and <10, respectively.⁹ Acetone is

⁹ GWP for acetone comes from IPCC, 2007. GWP for isopentane is estimated based on GWP of butane from IPCC, 2007 and the relative atmospheric lifetimes of butane and isopentane from : *Safeguarding the Ozone Layer and the Global Climate System*. IPCC/TEAP, 2005 – Bert Metz, Lambert Kuijpers, Susan Solomon, Stephen O. Anderson, Ogunlade Davidson, Jose Pons, David de Jager, Tahl Kestin, Martin Manning, and Leo Meyer (Eds.). Cambridge University Press, UK, pp 478. Available from Cambridge University Press, The Edinburgh Building Shaftesbury Road, Cambridge CB2 2RU ENGLAND Available online at <https://www.ipcc.ch/report/sroc>

excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS, while isopentane is defined as VOC under those regulations.

Flammability information: Acetone/isopentane blend is flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include drowsiness or dizziness. Higher concentrations may cause central nervous system depression and loss of consciousness. The substitute may also irritate the skin or eyes. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. These potential health effects are common to many foam-blowing agents.

For acetone, the Occupational Safety and Health Administration (OSHA) has established a permissible exposure limit (PEL) of 1000 ppm and the American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value (TLV) of 750 ppm, both on an 8-hr TWA. For isopentane, ACGIH has established a TLV of 600 ppm on an 8-hr TWA. EPA anticipates that users will be able to meet the ACGIH's TLVs for both components and address potential health risks by following requirements and recommendations in the manufacturer's SDS and other safety precautions common to the foam-blowing industry.

Comparison to other substitutes in this end-use: Acetone/isopentane blend has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.012.

For rigid polyurethane and polyisocyanurate laminated boardstock, acetone/isopentane blend's GWP of <10 is comparable to the GWPs of other acceptable substitutes for rigid polyurethane and polyisocyanurate laminated boardstock, including Ecomate™, CO₂, HFO-1336mzz(Z) and C3-C6 light saturated hydrocarbons with GWPs ranging from less than 1 to approximately 12.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the ACGIH TLVs, recommendations in the manufacturer's SDS, and other safety precautions common in the foam-blowing industry.

EPA finds acetone/isopentane blend acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

C. Fire Suppression and Explosion Protection

1. Powdered Aerosol E (FirePro™)

EPA's decision: EPA finds Powdered Aerosol E acceptable as a substitute for:

- Total flooding uses

Powdered Aerosol E is generated in an automated manufacturing process during which the chemicals, in powder form, are mixed and then supplied to end users as a solid contained within a fire extinguisher. In the presence of heat, the solid converts to an aerosol consisting mainly of potassium salts. EPA previously listed Powdered Aerosol E as acceptable subject to use conditions in areas that are not normally occupied (71 FR 56359; September 27, 2006). Based on a review of additional information from the submitter to support the safe use of

Powdered Aerosol E in normally occupied spaces, EPA now determines that Powdered Aerosol E is also acceptable for use in total flooding systems for normally occupied spaces, and EPA is adding Powdered Aerosol E to the list of acceptable substitutes for total flooding uses, which would include both unoccupied and occupied spaces. In a subsequent rulemaking EPA will remove the previous listing as acceptable subject to use conditions. In the “Further Information” column of the tables summarizing today’s listing decisions and found at the end of this document, we also state that use of this agent should continue to be in accordance with the safety guidelines in the latest edition of the National Fire Protection Association (NFPA) 2010 Standard for Aerosol Extinguishing Systems.

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 34 Listing of Powdered Aerosol E (FirePro) in Fire Suppression. SNAP Submission Received November 17, 2016.” EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Total Flooding Systems in Occupied Spaces
Substitute: Powdered Aerosol E (FirePro)”

Environmental information: The active ingredients of Powdered Aerosol E are solids both before and after use; thus, their ODP and GWP are both zero. The gaseous post-activation products for Powdered Aerosol E also have zero ODP and GWPs of 120 or less. The solid active ingredients and particulate post-activation products do not participate in atmospheric photochemical reactions and are not VOCs. The gaseous post-activation products are either not

organic or excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS.

Flammability information: Powdered Aerosol E's post-activation products are nonflammable.

Toxicity and exposure data: Exposure to Powdered Aerosol E after activation may cause temporary, mild irritation of the mucous membrane. If eye or skin contact occurs, end users should flush eyes with water or wash skin with soap and water. If inhaled, end users should be removed and exposed to fresh air. Exposure to the post-discharge products is expected to be below the relevant workplace exposure limits for those compounds. Because it is housed in a hermetically sealed container, exposure should not occur unless the system is activated.

The post-activation components of the proposed substitute are common compounds that are not expected to exceed immediately dangerous to life or health (IDLH) levels from the National Institute for Occupational Safety and Health (NIOSH) that apply to occupational and end use exposure.

Information on additional safety recommendations: The discharge of the aerosol results in a reduction of visibility in the protected space due to the uniform distribution of the particulate generated. Use according to the NFPA 2010 Standard will reduce any safety risks due to reduced visibility. In addition, EPA recommends that cross-zone detection systems and abort switches located near an exit from the protected space be employed; improved detection systems within the protected space and manual abort switches outside of the space could help avoid inadvertent discharge.

In the “Further Information” column of the tables summarizing today’s listing decisions, EPA recommends the following for establishments manufacturing Powdered Aerosol E and filling containers to be used in total flooding applications:

—Workers should use appropriate safety and protective equipment (e.g., protective gloves, tightly sealed goggles, protective work clothing, and particulate-removing respirators using NIOSH type N95 or better filters) consistent with OSHA guidelines.

—A local exhaust system should be installed and operated to provide adequate ventilation to reduce airborne exposure to Powdered Aerosol E constituents.

—An eye wash fountain and quick drench facility should be close to the production area.

—Training for safe handling procedures should be provided to all employees that would be likely to handle the containers of the agent or extinguishing units filled with the agent.

—Workers responsible for cleanup should allow particulates to settle before reentering area and wear appropriate personal protective equipment.

—All spills should be cleaned up immediately in accordance with good industrial hygiene practices.

EPA expects that procedures identified in the SDS for Powdered Aerosol E and good manufacturing practices will be adhered to, and that the appropriate safety and personal protective equipment (PPE) consistent with OSHA guidelines will be used during installation, servicing, post-discharge clean-up and disposal of total flooding systems using Powdered Aerosol E. The manufacturer should provide guidance upon installation of the system regarding the appropriate time after which workers may re-enter the area for disposal to allow the maximum settling of all particulates.

Comparison to other substitutes in this end-use: Powdered Aerosol E has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.048.

For total flooding agents, Powdered Aerosol E's GWP of 0 (and 1 to 120 for certain post-activation products) is lower than that of other acceptable substitutes, such as HFC-227ea, other HFCs, and some HCFC fire suppressants, with GWPs which range from about 1,550 to 14,800. Other acceptable substitutes in this end-use have comparable GWPs ranging from zero to one, such as water, inert gases, and a number of other powdered aerosol fire suppressants.

Toxicity risks can be minimized by use consistent with the NFPA 2010 standard, recommendations in the SDS, and other safety precautions common in the fire suppression industry. The potential toxicity risks due to inhalation exposure are common to many total flooding agents, including those already listed as acceptable under SNAP for this same end-use. Powdered Aerosol E's post-activation products are nonflammable, as are all other available total flooding agents.

EPA finds Powdered Aerosol E acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

D. Cleaning Solvents

1. HFO-1336mzz(Z)

EPA's decision: EPA finds HFO-1336mzz(Z)) acceptable as a substitute for use

in:

- Electronics cleaning

- Metals cleaning
- Precision cleaning

HFO-1336mzz(Z) is also known as (Z)-1,1,1,4,4,4-hexafluoro-2-butene and *cis*-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 692-49-9).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, “Supporting Documentation for Notice 34 Listing of HFO-1336mzz(Z) in Cleaning Solvents and Aerosol Solvents. SNAP Submission Received June 19, 2017.” EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Cleaning Solvents Substitute: HFO-1336mzz(Z)”

EPA previously listed HFO-1336mzz(Z) as acceptable for use in several refrigeration and air conditioning and foam-blowing end-uses (October 21, 2014, 79 FR 62863; July 16, 2015, 80 FR 42053; May 23, 2016, 81 FR 32241).

Environmental information: HFO-1336mzz(Z) has an ODP of zero. It has a 100-year GWP of about nine¹⁰. HFO-1336mzz(Z) is a VOC, and it is not exempted from the definition of VOC under CAA regulation (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. EPA has issued a proposed rule that, if finalized as proposed,

¹⁰ Baasandorj, M., Ravishankara, A.R., Burkholder, J.B., Atmospheric Chemistry of (Z)-CF₃CH₂CHCF₃: OH Radical Reaction Rate Coefficient and Global Warming Potential, *Journal of Physical Chemistry A*, 2011, 115, 10,539–10,549, 2011.

would exclude HFO-1336mzz(Z) from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS (May 1, 2018; 83 FR 19026).

Flammability information: HFO-1336mzz(Z) is not flammable.

Toxicity and exposure data: Potential health effects of exposure to this substitute include skin or eye irritation or frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. EPA issued a Significant New Use Rule under the Toxic Substances Control Act on June 5, 2015, to require persons to submit a Significant New Use Notice to EPA at least 90 days before they manufacture or process HFO-1336mzz(Z) for uses other than those described in the Premanufacture Notice (80 FR 32003).

EPA anticipates that HFO-1336mzz(Z) will be used consistent with the recommendations specified in the SDS. The WEEL committee of the Occupational Alliance for Risk Science (OARS) recommends a WEEL for the workplace of 500 ppm on an 8-hour TWA. EPA anticipates that users will be able to meet the WEEL and address potential health risks by following requirements and recommendations in the SDS and other safety precautions common to the cleaning solvents industry.

Comparison to other substitutes in this end-use: HFO-1336mzz(Z) has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.033.

For cleaning solvents, HFO-1336mzz(Z)'s GWP of about nine is lower than that of other acceptable substitutes, such as HFE-7200, HFE-7100, HFC-365mfc and HFC-4310mee with GWPs ranging from 59 to 1,640. HFO-1336mzz(Z)'s GWP is higher than or comparable to the

GWPs of other acceptable substitutes for cleaning solvents, including acetone, methoxytridecafluoroheptene isomers (MPHE), and trans-1-chloro-3,3,3-trifluoroprop-1-ene with GWPs ranging from less than 1 to 7.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the OARS WEEL, recommendations in the manufacturer's SDS, and other safety precautions common in the cleaning solvents industry; moreover, those risks are common to many cleaning solvents, including many of those already listed as acceptable under SNAP for this end-use.

EPA finds HFO-1336mzz(Z) acceptable in the end-uses listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-uses.

E. Aerosols

1. HFO-1336mzz(Z)

EPA's decision: EPA finds HFO-1336mzz(Z) acceptable as a substitute for use in:

- Aerosol solvents

HFO-1336mzz(Z) is also known as (Z)-1,1,1,4,4,4-hexafluoro-2-butene and *cis*-1,1,1,4,4,4-hexafluoro-2-butene (CAS Reg. No. 692-49-9).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at www.regulations.gov under the name, "Supporting Documentation for Notice 34 Listing of HFO-1336mzz(Z) in Cleaning Solvents and Aerosol Solvents. SNAP Submission Received June

19, 2017.” EPA performed an assessment to examine the health and environmental risks of this substitute. This assessment is available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Aerosol Solvents Substitute: HFO-1336mzz(Z)”

EPA previously listed HFO-1336mzz(Z) as acceptable for use in several refrigeration and air conditioning and foam-blowing end-uses (October 21, 2014, 79 FR 62863; July 16, 2015, 80 FR 42053; May 23, 2016, 81 FR 32241).

Environmental information: The environmental information for this substitute is set forth in the “Environmental information” section in listing I.D.1.

Flammability information: HFO-1336mzz(Z) is not flammable.

Toxicity and exposure data: The toxicity information for this substitute is set forth in the “Toxicity and exposure data” section in listing I.D.1, above.

EPA anticipates that HFO-1336mzz(Z) will be used consistent with the recommendations specified in the SDS. The WEEL committee of the Occupational Alliance for Risk Science (OARS) recommends a WEEL for the workplace of 500 ppm on an 8-hour TWA. EPA anticipates that users will be able to meet the WEEL and address potential health risks by following requirements and recommendations in the SDS and other safety precautions common to the aerosols industry.

Comparison to other substitutes in this end-use: HFO-1336mzz(Z) has an ODP of zero, comparable to other listed substitutes in this end-use, with ODPs ranging from zero to 0.033.

For aerosol solvents, HFO-1336mzz(Z)'s GWP of about nine is lower than that of other acceptable substitutes, such as HFE-7200, HFE-7000, HFC-365mfc and HFC-4310mee with GWPs ranging from 59 to 1,640. HFO-1336mzz(Z)'s GWP is higher than or comparable to the GWPs of other acceptable substitutes for aerosol solvents, including acetone, MPHE, and trans-1-chloro-3,3,3-trifluoroprop-1-ene with GWPs ranging from less than 1 to 7.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Toxicity risks can be minimized by use consistent with the OARS WEEL, recommendations in the manufacturer's SDS, and other safety precautions common in the aerosols industry; moreover, those risks are common to many aerosol solvents, including many of those already listed as acceptable under SNAP for this end-use.

EPA finds HFO-1336mzz(Z) acceptable in the end-use listed above because it does not pose greater overall environmental and human health risk than other available substitutes in the same end-use.

List of Subjects in 40 CFR Part 82

Environmental protection, Administrative practice and procedure, Air pollution control, Reporting and recordkeeping requirements.

Dated: September 19, 2018.

Sarah Dunham, Director
Office of Atmospheric Programs

APPENDIX A: SUMMARY OF DECISIONS FOR NEW ACCEPTABLE SUBSTITUTES

Refrigeration and Air Conditioning

End-Use	Substitute	Decision	Further Information ¹
Ice skating rinks (<i>retrofit equipment only</i>).	R-448A	Acceptable	<p>R-448A has a 100-yr global warming potential (GWP) of approximately 1,390. This substitute is a blend of HFC-32, which is also known as difluoromethane (CAS Reg. No. 75-10-5); HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); HFO-1234yf, which is also known as 2,3,3,3-tetrafluoro-prop-1-ene (CAS Reg. No. 754-12-1); and HFO-1234ze(E), which is also known as <i>trans</i>-1,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 29118-24-9).</p> <p>The blend is nonflammable.</p> <p>The American Industrial Hygiene Association (AIHA) has established Workplace Environmental Exposure Limits (WEELs) of 1,000 ppm on an eight-hour time-weighted average (8-hr TWA) basis for HFC-32, HFC-125, and HFC-134a; 500 ppm for HFO-1234yf; and 800 ppm for HFO-1234ze(E). The manufacturer recommends an acceptable exposure limit (AEL) for the workplace for R-448A of 890 ppm (8-hr TWA).</p>
Ice skating rinks (<i>retrofit equipment only</i>).	R-449A	Acceptable	<p>R-449A has a 100-year GWP of approximately 1,400. This substitute is a blend of HFC-32, which is also known as difluoromethane (CAS Reg. No. 75-10-5); HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).</p> <p>The blend is nonflammable.</p> <p>The AIHA has established WEELs of 1,000 ppm (8-hr TWA) for HFC-32, HFC-125, and HFC-134a; and 500 ppm for HFO-1234yf. The manufacturer recommends an AEL for the workplace for R-449A of 830 ppm (8-hr TWA).</p>

End-Use	Substitute	Decision	Further Information ¹
Ice skating rinks (<i>retrofit equipment only</i>).	R-449B	Acceptable	<p>R-449B has a 100-year GWP of approximately 1,410. This substitute is a blend of HFC-32, which is also known as difluoromethane (CAS Reg. No. 75-10-5); HFC-125, which is also known as 1,1,1,2,2-pentafluoroethane (CAS Reg. No. 354-33-6); HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).</p> <p>The blend is nonflammable.</p> <p>The AIHA has established WEELs of 1,000 ppm (8-hr TWA) for HFC-32, HFC-125, and HFC-134a; and 500 ppm for HFO-1234yf. The manufacturer recommends an AEL for the workplace for R-449B of 865 ppm (8-hr TWA).</p>
Ice skating rinks (<i>new and retrofit equipment</i>).	R-450A	Acceptable	<p>R-450A has a 100-year GWP of approximately 600. This substitute is a blend of HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and HFO-1234ze(E), which is also known as trans-1,3,3,3, -tetrafluoropro-1-ene (CAS Reg. No. 29118-24-9).</p> <p>This blend is nonflammable.</p> <p>The AIHA has established WEELs of 1,000 ppm and 800 ppm (8-hr TWA) for HFC-134a and HFO-1234yf, respectively. The manufacturer recommends an AEL for the workplace for R-450A of 880 ppm (8-hr TWA).</p>
Ice skating rinks (<i>new and retrofit equipment</i>).	R-513A	Acceptable	<p>R-513A has a 100-year GWP of approximately 630. This substitute is a blend of HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).</p> <p>This blend is nonflammable.</p> <p>The AIHA has established WEELs of 1,000 ppm and 500 ppm (8-hr TWA) for HFC-134a and HFO-1234yf, respectively. The manufacturer recommends an AEL for the workplace for R-513A of 653 ppm (8-hr TWA).</p>

Foam Blowing

End-Use	Substitute	Decision	Further Information ¹
Rigid polyurethane and polyisocyanurate laminated boardstock	Acetone/isopentane blend	Acceptable	<p>Acetone/isopentane blend has no ozone depletion potential (ODP) and a 100-year GWP of approximately <10. Acetone is excluded from the definition of volatile organic compounds (VOC) under CAA regulations (see 40 CFR 51.100(s)) addressing the development of state implementation plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS), while isopentane is defined as VOC.</p> <p>This foam-blowing agent is flammable.</p> <p>For acetone, the Occupational Safety and Health Administration (OSHA) has established a permissible exposure limit of 1000 ppm and the American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value (TLV) of 750 ppm, both on an 8-hr TWA. For isopentane, ACGIH has established a TLV of 600 ppm on an 8-hr TWA.</p>

Fire Suppression

End-Use	Substitute	Decision	Further Information ¹
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End-Use	Substitute	Decision	Further Information ¹
Total flooding	Powdered Aerosol E	Acceptable	<p>Use of this agent should be in accordance with the safety guidelines in the latest edition of the National Fire Protection Association 2010 standard for Aerosol Extinguishing Systems.</p> <p>For establishments manufacturing the agent or filling, installing, or servicing containers or systems to be used in total flooding applications, EPA recommends the following:</p> <ul style="list-style-type: none"> —the appropriate safety and personal protective equipment (PPE) (e.g., protective gloves, tightly sealed goggles, protective work clothing, and particulate-removing respirators with National Institute for Occupational Safety and Health type N95 or better filters) consistent with Occupational Safety and Health Administration (OSHA) guidelines should be used during manufacture, installation, servicing, and disposal of total flooding systems using the agent; —adequate ventilation should be in place to reduce airborne exposure to constituents of agent; —an eye wash fountain and quick drench facility should be close to the production area; —training for safe handling procedures should be provided to all employees that would be likely to handle containers of the agent or extinguishing units filled with the agent; —workers responsible for clean-up should allow for maximum settling of all particulates before reentering area and wear appropriate personal protective equipment; and —all spills should be cleaned up immediately in accordance with good industrial hygiene practices. <p>As required by the manufacturer, units installed in normally occupied spaces will be equipped with features such as a system-isolate switch and cross-zone detection system to reduce risk of accidental activation of an agent generator</p>

End-Use	Substitute	Decision	Further Information ¹
			<p>while persons are present in the protected space. Also required by the manufacturer is warning of pending discharge and delay in release to ensure egress prior to activation of the agent to reduce the risk of exposure.</p> <p>See additional comments 1, 2, 3, 4, 5.</p>

1. The EPA recommends that users consult Section VIII of the OSHA Technical Manual for information on selecting the appropriate types of personal protective equipment for all listed fire suppression agents. The EPA has no intention of duplicating or displacing OSHA coverage related to the use of personal protective equipment (e.g., respiratory protection), fire protection, hazard communication, worker training or any other occupational safety and health standard with respect to halon substitutes.

2. Use of all listed fire suppression agents should conform to relevant OSHA requirements, including 29 CFR part 1910, subpart L, sections 1910.160 and 1910.162.

3. Per OSHA requirements, protective gear (SCBA) should be available in the event personnel should reenter the area.

4. Discharge testing should be strictly limited to that which is essential to meet safety or performance requirements.

5. The agent should be recovered from the fire protection system in conjunction with testing or servicing, and recycled for later use or destroyed.

Cleaning Solvents

End-Use	Substitute	Decision	Further Information ¹
Electronics cleaning, metals cleaning, precision cleaning	HFO-1336mzz(Z)	Acceptable	<p>HFO-1336mzz(Z) has no ozone depletion potential (ODP) and a 100-year GWP of approximately nine. EPA has proposed to exclude it from the definition of volatile organic compounds under CAA regulations (see 40 CFR 51.100(s)) addressing the development of state implementation plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS).</p> <p>This compound is nonflammable.</p> <p>The Occupational Alliance for Risk Science (OARS) has established a Workplace Environmental Exposure Limit (WEEL) of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).</p> <p>This substitute is subject to a Toxic Substance Control Act (TSCA) section 5(a)(2) Significant New Use Rule (SNUR) (40 CFR 721.10830).</p>

¹ Observe recommendations in the manufacturer's SDS and guidance for all listed substitutes.

Aerosols

End-Use	Substitute	Decision	Further Information ¹
Aerosol solvents	HFO-1336mzz(Z)	Acceptable	<p>HFO-1336mzz(Z) has no ozone depletion potential (ODP) and a 100-year GWP of approximately nine. EPA has proposed to exclude it from the definition of volatile organic compounds under CAA regulations (see 40 CFR 51.100(s)) addressing the development of state implementation plans (SIPs) to attain and maintain the National Ambient Air Quality Standards (NAAQS).</p> <p>This compound is nonflammable.</p> <p>The OARS has established a Workplace Environmental Exposure Limit (WEEL) of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).</p> <p>This substitute is subject to a Toxic Substance Control Act (TSCA) section 5(a)(2) Significant New Use Rule (SNUR) (40 CFR 721.10830).</p>

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